This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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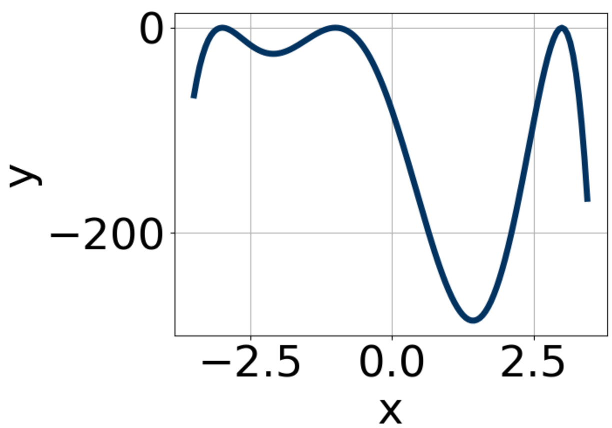
1. Which of the following equations *could* be of the graph presented below?



The solution is $-18(x+3)^6(x+1)^4(x-3)^8$, which is option A.

A. $-18(x+3)^6(x+1)^4(x-3)^8$

* This is the correct option.

B. $12(x+3)^8(x+1)^4(x-3)^7$

The factor $(x-3)$ should have an even power and the leading coefficient should be the opposite sign.

C. $-7(x+3)^6(x+1)^{10}(x-3)^7$

The factor $(x-3)$ should have an even power.

D. $8(x+3)^6(x+1)^6(x-3)^6$

This corresponds to the leading coefficient being the opposite value than it should be.

E. $-12(x+3)^{10}(x+1)^{11}(x-3)^5$

The factors $(x+1)$ and $(x-3)$ should both have even powers.

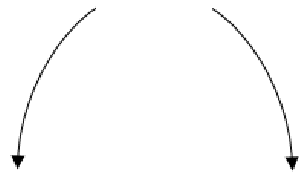
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

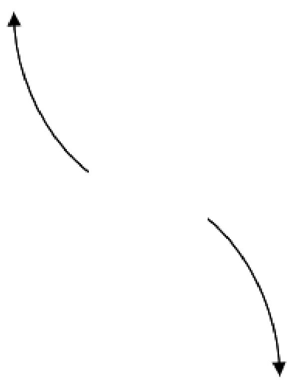
---

2. Describe the end behavior of the polynomial below.

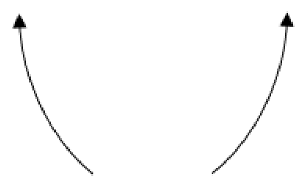
$$f(x) = -9(x+8)^2(x-8)^5(x-6)^2(x+6)^3$$

The solution is the graph below, which is option B.

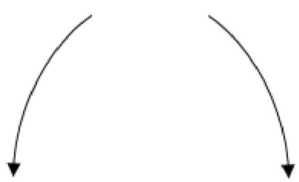




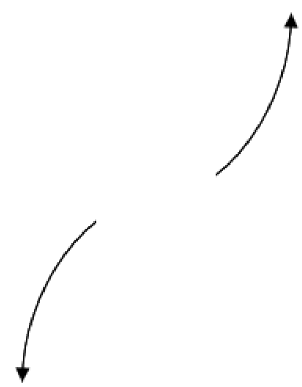
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

3. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$4 + 3i \text{ and } 1$$

The solution is $x^3 - 9x^2 + 33x - 25$, which is option C.

A. $b \in [1, 2], c \in [-6, -4.35],$ and $d \in [3.48, 4.06]$

$x^3 + x^2 - 5x + 4$, which corresponds to multiplying out $(x - 4)(x - 1)$.

B. $b \in [1, 2], c \in [-4.24, -2.63],$ and $d \in [2.96, 3.37]$

$x^3 + x^2 - 4x + 3$, which corresponds to multiplying out $(x - 3)(x - 1)$.

C. $b \in [-17, -7], c \in [31.51, 33.82],$ and $d \in [-25.2, -24.86]$

* $x^3 - 9x^2 + 33x - 25$, which is the correct option.

D. $b \in [8, 10], c \in [31.51, 33.82],$ and $d \in [24.44, 25.5]$

$x^3 + 9x^2 + 33x + 25$, which corresponds to multiplying out $(x - (4 + 3i))(x - (4 - 3i))(x + 1)$.

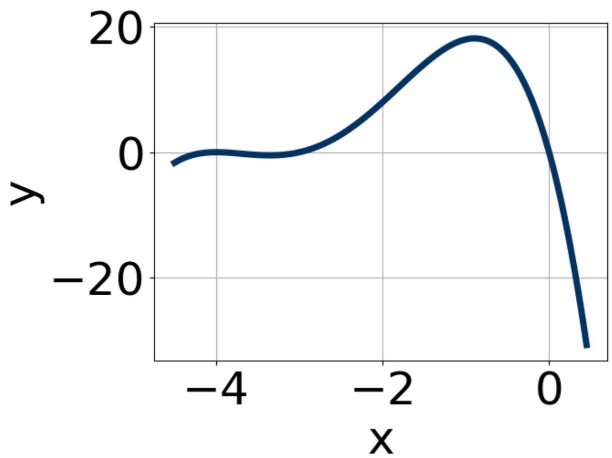
E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (4 + 3i))(x - (4 - 3i))(x - (1))$.

---

4. Which of the following equations *could* be of the graph presented below?



The solution is $-5x^5(x + 4)^8(x + 3)^7$, which is option A.

A. $-5x^5(x + 4)^8(x + 3)^7$

* This is the correct option.

B. $-19x^6(x + 4)^6(x + 3)^7$

The factor x should have an odd power.

C. $-14x^{10}(x + 4)^9(x + 3)^5$

The factor -4 should have an even power and the factor 0 should have an odd power.

D. $10x^{11}(x + 4)^8(x + 3)^{10}$

The factor $(x + 3)$ should have an odd power and the leading coefficient should be the opposite sign.

E. $19x^{11}(x + 4)^4(x + 3)^7$

This corresponds to the leading coefficient being the opposite value than it should be.

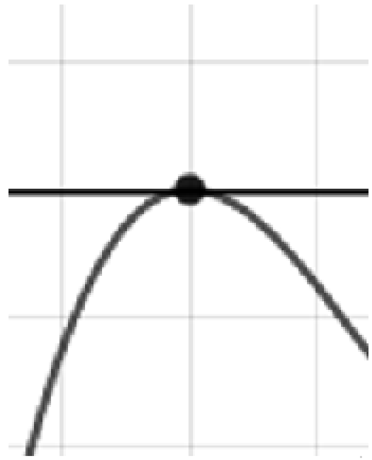
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

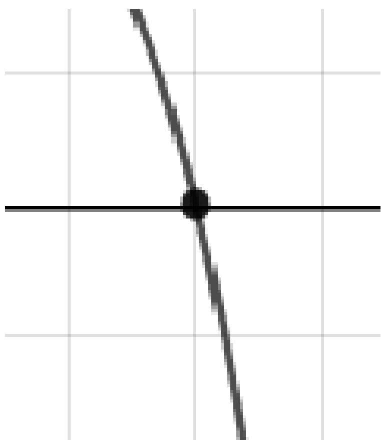
---

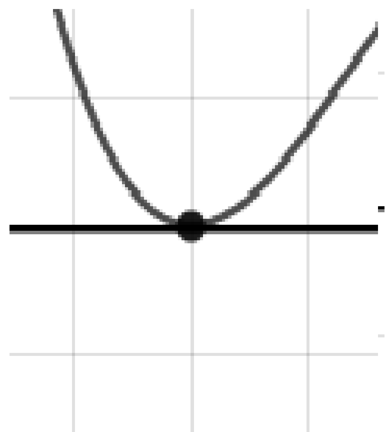
5. Describe the zero behavior of the zero $x = 8$ of the polynomial below.

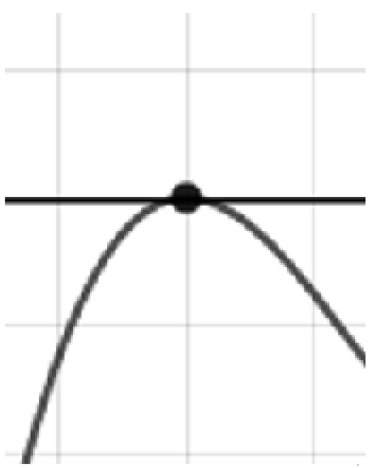
$$f(x) = -9(x - 6)^9(x + 6)^6(x - 8)^{12}(x + 8)^9$$

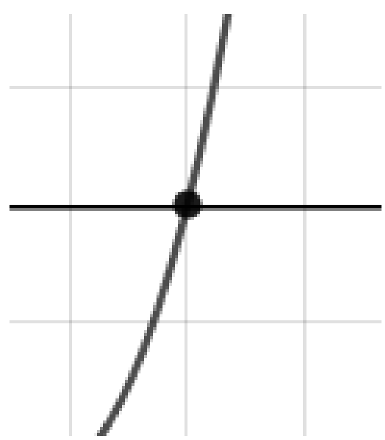
The solution is the graph below, which is option B.



A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

6. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain

the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{3}{2}, 5, \text{ and } \frac{-4}{3}$$

The solution is $6x^3 - 31x^2 - 7x + 60$, which is option B.

A. $a \in [0, 10], b \in [45, 52], c \in [97, 103],$ and $d \in [55, 64]$

$6x^3 + 47x^2 + 97x + 60$, which corresponds to multiplying out $(2x + 3)(x + 5)(3x + 4)$.

B. $a \in [0, 10], b \in [-34, -27], c \in [-9, -4],$ and $d \in [55, 64]$

* $6x^3 - 31x^2 - 7x + 60$, which is the correct option.

C. $a \in [0, 10], b \in [-34, -27], c \in [-9, -4],$ and $d \in [-66, -56]$

$6x^3 - 31x^2 - 7x - 60$, which corresponds to multiplying everything correctly except the constant term.

D. $a \in [0, 10], b \in [26, 37], c \in [-9, -4],$ and $d \in [-66, -56]$

$6x^3 + 31x^2 - 7x - 60$, which corresponds to multiplying out $(2x + 3)(x + 5)(3x - 4)$.

E. $a \in [0, 10], b \in [-13, -7], c \in [-76, -68],$ and $d \in [-66, -56]$

$6x^3 - 13x^2 - 73x - 60$, which corresponds to multiplying out $(2x + 3)(x - 5)(3x + 4)$.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(2x - 3)(x - 5)(3x + 4)$

---

7. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 + 2i \text{ and } 2$$

The solution is $x^3 + 4x^2 + x - 26$, which is option C.

A. $b \in [-5.5, -1.2], c \in [-3, 3],$ and $d \in [24, 27]$

$x^3 - 4x^2 + x + 26$, which corresponds to multiplying out $(x - (-3 + 2i))(x - (-3 - 2i))(x + 2)$.

B. $b \in [0.7, 1.5], c \in [-6, -3],$ and $d \in [0, 9]$

$x^3 + x^2 - 4x + 4$, which corresponds to multiplying out $(x - 2)(x - 2)$.

C. $b \in [3.8, 5.3], c \in [-3, 3],$ and $d \in [-32, -24]$

* $x^3 + 4x^2 + x - 26$, which is the correct option.

D. $b \in [0.7, 1.5], c \in [-3, 3],$ and $d \in [-10, -3]$

$x^3 + x^2 + x - 6$, which corresponds to multiplying out $(x + 3)(x - 2)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-3 + 2i))(x - (-3 - 2i))(x - (2))$.

---

8. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-3}{5}, \frac{-7}{2}, \text{ and } \frac{-3}{2}$$

The solution is $20x^3 + 112x^2 + 165x + 63$, which is option C.

A. $a \in [15, 23], b \in [110, 119], c \in [165, 169], \text{ and } d \in [-64, -58]$

$20x^3 + 112x^2 + 165x - 63$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [15, 23], b \in [-117, -109], c \in [165, 169], \text{ and } d \in [-64, -58]$

$20x^3 - 112x^2 + 165x - 63$, which corresponds to multiplying out $(5x - 3)(2x - 7)(2x - 3)$.

C. $a \in [15, 23], b \in [110, 119], c \in [165, 169], \text{ and } d \in [54, 68]$

* $20x^3 + 112x^2 + 165x + 63$, which is the correct option.

D. $a \in [15, 23], b \in [-53, -49], c \in [-85, -80], \text{ and } d \in [54, 68]$

$20x^3 - 52x^2 - 81x + 63$, which corresponds to multiplying out $(5x - 3)(2x - 7)(2x + 3)$.

E. $a \in [15, 23], b \in [88, 93], c \in [36, 51], \text{ and } d \in [-64, -58]$

$20x^3 + 88x^2 + 45x - 63$, which corresponds to multiplying out $(5x - 3)(2x + 7)(2x + 3)$.

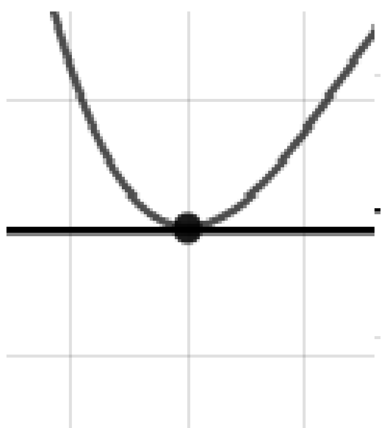
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x + 3)(2x + 7)(2x + 3)$

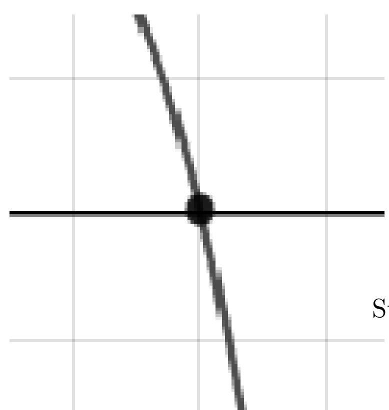
---

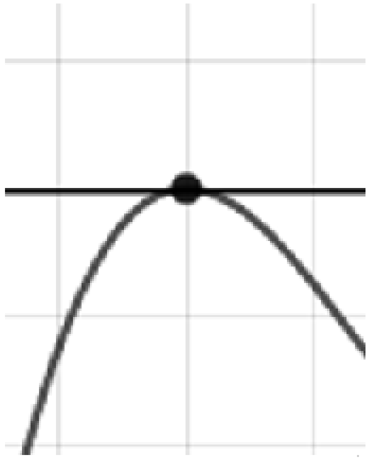
9. Describe the zero behavior of the zero $x = 7$ of the polynomial below.

$$f(x) = 2(x + 7)^7 (x - 7)^{10} (x - 3)^4 (x + 3)^8$$

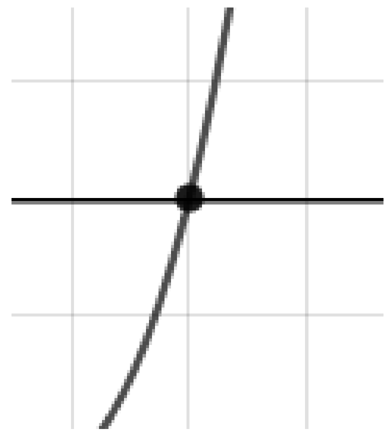
The solution is the graph below, which is option C.





B. 

C. 

D. 

E. None of the above.

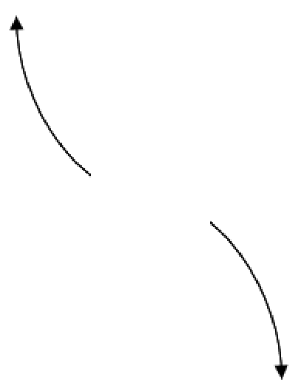
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

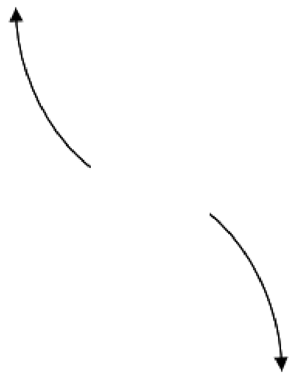
---

10. Describe the end behavior of the polynomial below.

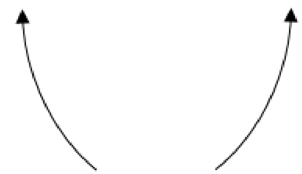
$$f(x) = -3(x+4)^3(x-4)^6(x-5)^5(x+5)^7$$

The solution is the graph below, which is option A.

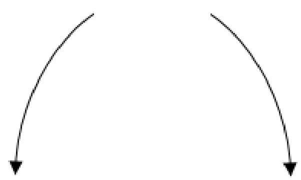




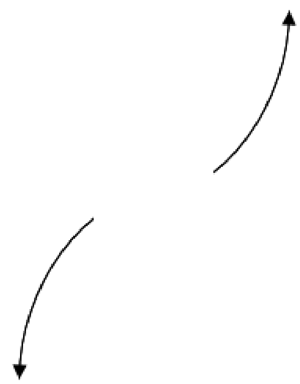
A.



C.



B.



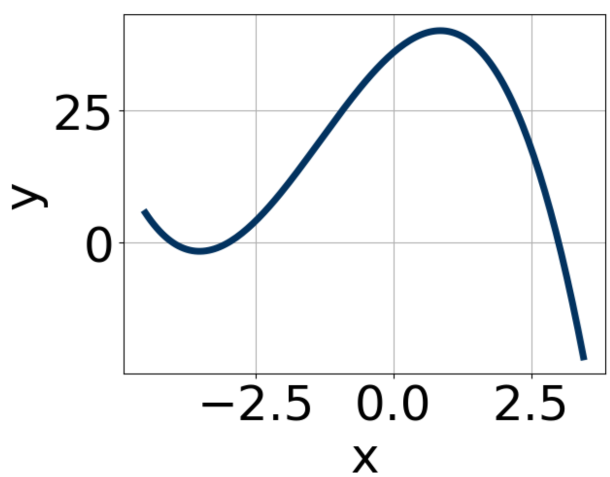
D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

11. Which of the following equations *could* be of the graph presented below?



The solution is $-3(x-3)^7(x+4)^9(x+3)^{11}$, which is option B.

A. $-20(x-3)^6(x+4)^{11}(x+3)^5$

The factor 3 should have been an odd power.

B. $-3(x-3)^7(x+4)^9(x+3)^{11}$

* This is the correct option.

C. $6(x-3)^4(x+4)^{11}(x+3)^9$

The factor $(x-3)$ should have an odd power and the leading coefficient should be the opposite sign.

D. $-3(x-3)^4(x+4)^8(x+3)^9$

The factors 3 and -4 have have been odd power.

E. $18(x-3)^5(x+4)^5(x+3)^{11}$

This corresponds to the leading coefficient being the opposite value than it should be.

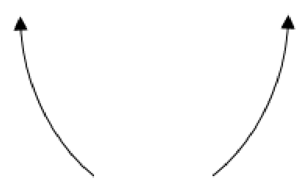
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

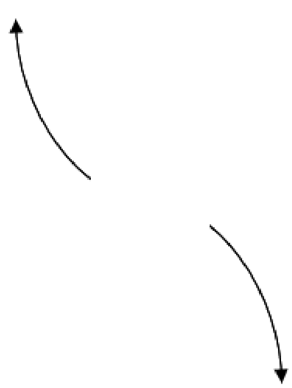
---

12. Describe the end behavior of the polynomial below.

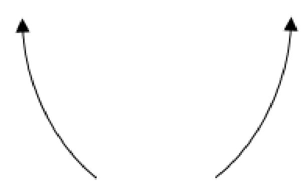
$$f(x) = 6(x+4)^5(x-4)^6(x-3)^4(x+3)^5$$

The solution is the graph below, which is option C.

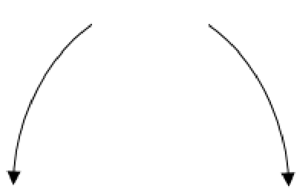




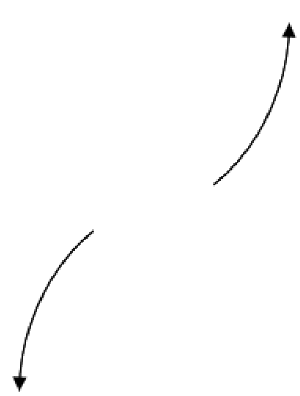
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

13. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-5 + 5i \text{ and } -3$$

The solution is $x^3 + 13x^2 + 80x + 150$, which is option B.

A. $b \in [-1, 9], c \in [-8, 1], \text{ and } d \in [-15, -11]$

$x^3 + x^2 - 2x - 15$, which corresponds to multiplying out $(x - 5)(x + 3)$.

B. $b \in [11, 16], c \in [80, 82], \text{ and } d \in [147, 158]$

* $x^3 + 13x^2 + 80x + 150$, which is the correct option.

C. $b \in [-1, 9], c \in [7, 11], \text{ and } d \in [11, 19]$

$x^3 + x^2 + 8x + 15$, which corresponds to multiplying out $(x + 5)(x + 3)$.

D. $b \in [-19, -12], c \in [80, 82], \text{ and } d \in [-158, -146]$

$x^3 - 13x^2 + 80x - 150$, which corresponds to multiplying out $(x - (-5 + 5i))(x - (-5 - 5i))(x - 3)$.

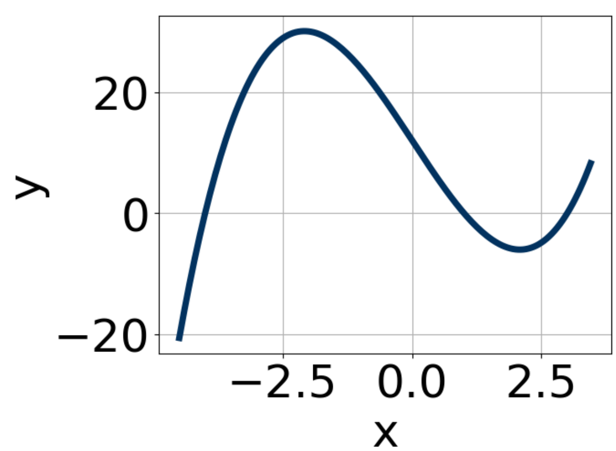
E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-5 + 5i))(x - (-5 - 5i))(x - (-3))$.

---

14. Which of the following equations *could* be of the graph presented below?



The solution is $9(x - 3)^7(x + 4)^{11}(x - 1)^{11}$, which is option C.

A. $3(x - 3)^4(x + 4)^8(x - 1)^5$

The factors 3 and -4 have have been odd power.

B. $-12(x-3)^4(x+4)^5(x-1)^7$

The factor $(x-3)$ should have an odd power and the leading coefficient should be the opposite sign.

C. $9(x-3)^7(x+4)^{11}(x-1)^{11}$

* This is the correct option.

D. $-12(x-3)^9(x+4)^{11}(x-1)^5$

This corresponds to the leading coefficient being the opposite value than it should be.

E. $10(x-3)^6(x+4)^{11}(x-1)^7$

The factor 3 should have been an odd power.

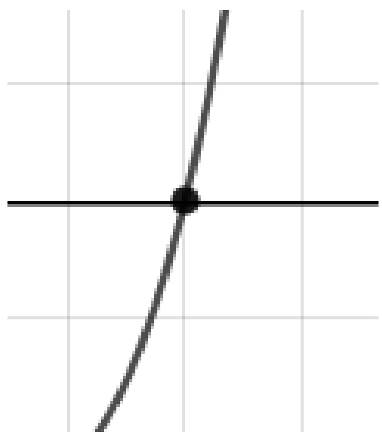
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

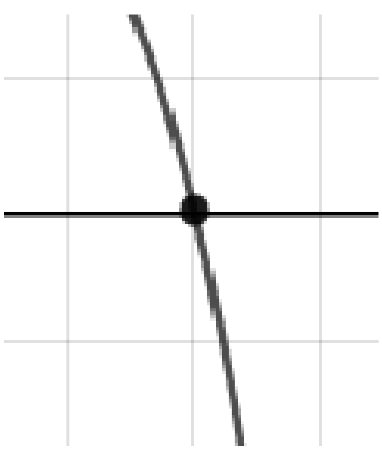
---

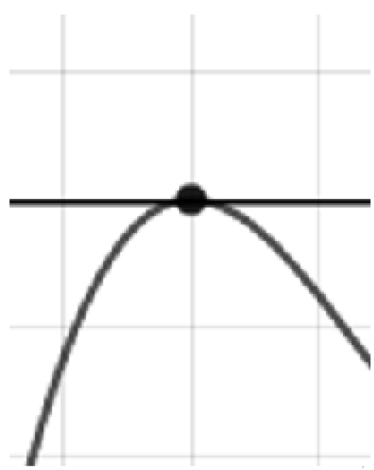
15. Describe the zero behavior of the zero $x = -8$ of the polynomial below.

$$f(x) = 9(x+2)^{11}(x-2)^7(x+8)^7(x-8)^6$$

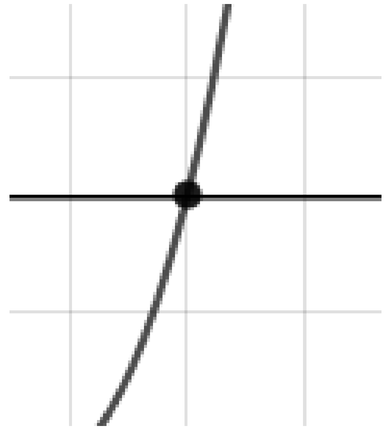
The solution is the graph below, which is option D.



A. 

B. 

C. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

16. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{5}{2}, \frac{-1}{3}, \text{ and } \frac{-2}{3}$$

The solution is $18x^3 - 27x^2 - 41x - 10$, which is option B.

A. $a \in [17, 23], b \in [19, 28], c \in [-45, -36], \text{ and } d \in [8, 11]$

$18x^3 + 27x^2 - 41x + 10$, which corresponds to multiplying out $(2x + 5)(3x - 1)(3x - 2)$.

B. $a \in [17, 23], b \in [-27, -24], c \in [-45, -36], \text{ and } d \in [-17, -9]$

* $18x^3 - 27x^2 - 41x - 10$, which is the correct option.

C. $a \in [17, 23], b \in [50, 54], c \in [3, 12], \text{ and } d \in [-17, -9]$

$18x^3 + 51x^2 + 11x - 10$, which corresponds to multiplying out $(2x + 5)(3x - 1)(3x + 2)$.

D. $a \in [17, 23], b \in [58, 75], c \in [44, 53], \text{ and } d \in [8, 11]$

$18x^3 + 63x^2 + 49x + 10$, which corresponds to multiplying out $(2x + 5)(3x + 1)(3x + 2)$.

E. $a \in [17, 23], b \in [-27, -24], c \in [-45, -36], \text{ and } d \in [8, 11]$

$18x^3 - 27x^2 - 41x + 10$, which corresponds to multiplying everything correctly except the constant term.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(2x - 5)(3x + 1)(3x + 2)$

---

17. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$4 + 5i \text{ and } -2$$

The solution is $x^3 - 6x^2 + 25x + 82$, which is option D.

A. $b \in [1, 3], c \in [-4.5, -2.7]$, and $d \in [-10.1, -9.4]$

$x^3 + x^2 - 3x - 10$, which corresponds to multiplying out $(x - 5)(x + 2)$.

B. $b \in [1, 3], c \in [-2.53, -1.56]$, and $d \in [-8.9, -6.6]$

$x^3 + x^2 - 2x - 8$, which corresponds to multiplying out $(x - 4)(x + 2)$.

C. $b \in [6, 11], c \in [22.96, 25.33]$, and $d \in [-83.9, -75.9]$

$x^3 + 6x^2 + 25x - 82$, which corresponds to multiplying out $(x - (4 + 5i))(x - (4 - 5i))(x - 2)$.

D. $b \in [-7, -3], c \in [22.96, 25.33]$, and $d \in [80.5, 82.2]$

* $x^3 - 6x^2 + 25x + 82$, which is the correct option.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (4 + 5i))(x - (4 - 5i))(x - (-2))$.

---

18. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{7}{5}, \frac{-1}{4}, \text{ and } \frac{2}{5}$$

The solution is $100x^3 - 155x^2 + 11x + 14$, which is option C.

A. $a \in [97, 103], b \in [75, 77], c \in [-81, -77]$, and $d \in [6, 19]$

$100x^3 + 75x^2 - 81x + 14$, which corresponds to multiplying out $(5x + 7)(4x - 1)(5x - 2)$.

B. $a \in [97, 103], b \in [-163, -151], c \in [5, 14]$, and $d \in [-14, -13]$

$100x^3 - 155x^2 + 11x - 14$, which corresponds to multiplying everything correctly except the constant term.

C. $a \in [97, 103], b \in [-163, -151], c \in [5, 14]$, and $d \in [6, 19]$

* $100x^3 - 155x^2 + 11x + 14$, which is the correct option.

D. $a \in [97, 103], b \in [147, 156], c \in [5, 14]$, and $d \in [-14, -13]$

$100x^3 + 155x^2 + 11x - 14$, which corresponds to multiplying out $(5x + 7)(4x - 1)(5x + 2)$.

E. $a \in [97, 103], b \in [119, 127], c \in [-37, -25]$, and $d \in [-14, -13]$

$100x^3 + 125x^2 - 31x - 14$, which corresponds to multiplying out $(5x + 7)(4x + 1)(5x - 2)$.

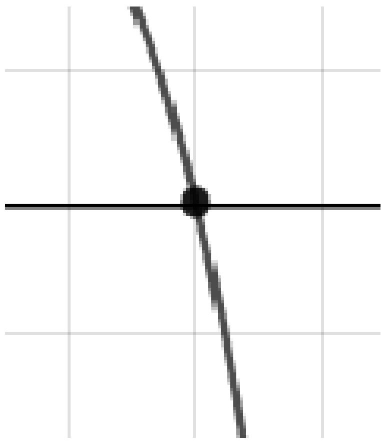
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x - 7)(4x + 1)(5x - 2)$

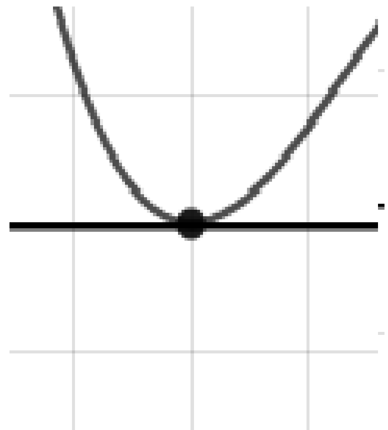
---

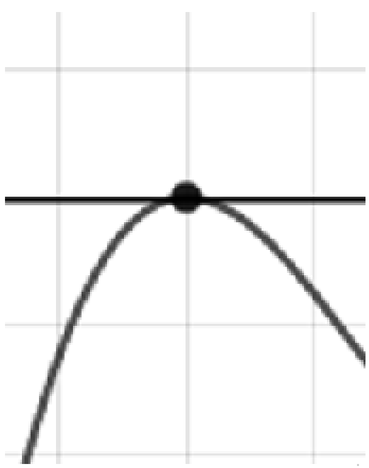
19. Describe the zero behavior of the zero $x = -6$ of the polynomial below.

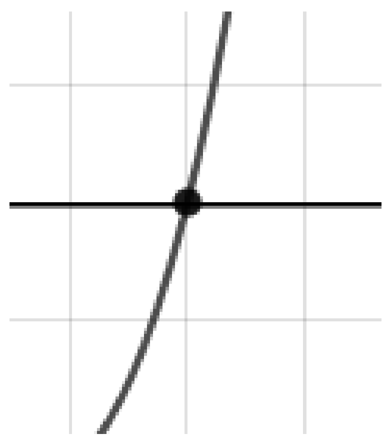
$$f(x) = 9(x - 6)^5(x + 6)^{10}(x - 9)^7(x + 9)^{11}$$

The solution is the graph below, which is option C.

A. 

C. 

B. 

D. 

E. None of the above.

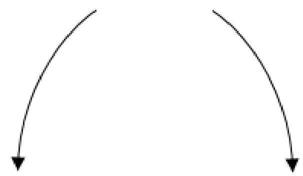
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

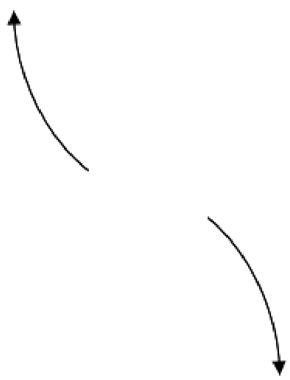
---

20. Describe the end behavior of the polynomial below.

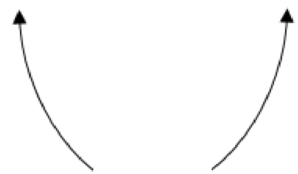
$$f(x) = -8(x-2)^4(x+2)^5(x+9)^5(x-9)^6$$

The solution is the graph below, which is option B.

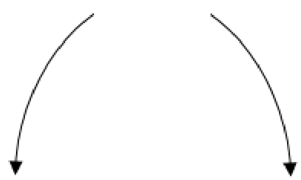




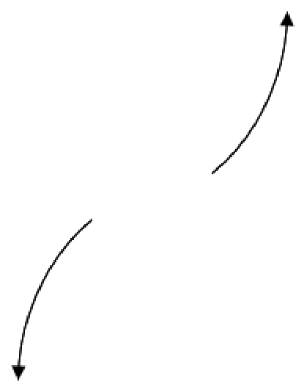
A.



C.



B.



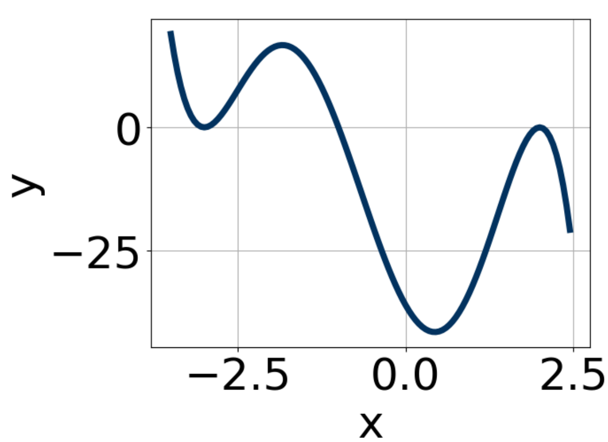
D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

21. Which of the following equations *could* be of the graph presented below?



The solution is $-18(x-2)^{10}(x+3)^{6}(x+1)^{11}$, which is option B.

A. $19(x-2)^{10}(x+3)^{6}(x+1)^{8}$

The factor $(x+1)$ should have an odd power and the leading coefficient should be the opposite sign.

B. $-18(x-2)^{10}(x+3)^{6}(x+1)^{11}$

* This is the correct option.

C. $-19(x-2)^{8}(x+3)^{9}(x+1)^{10}$

The factor $(x+3)$ should have an even power and the factor $(x+1)$ should have an odd power.

D. $13(x-2)^{10}(x+3)^{10}(x+1)^{5}$

This corresponds to the leading coefficient being the opposite value than it should be.

E. $-4(x-2)^{10}(x+3)^{5}(x+1)^{5}$

The factor $(x+3)$ should have an even power.

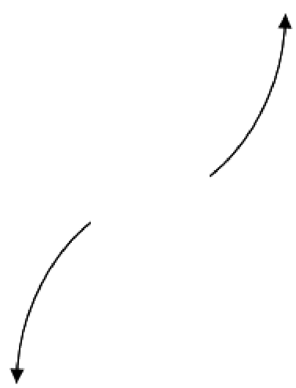
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

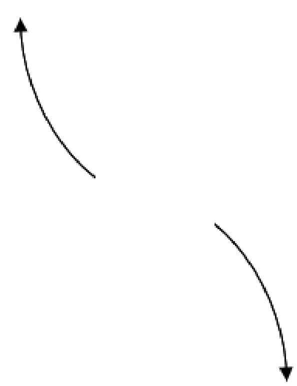
---

22. Describe the end behavior of the polynomial below.

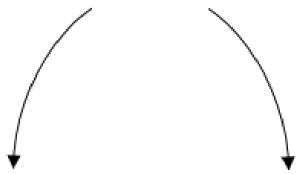
$$f(x)=4(x+6)^{4}(x-6)^{9}(x+9)^{3}(x-9)^{3}$$

The solution is the graph below, which is option D.

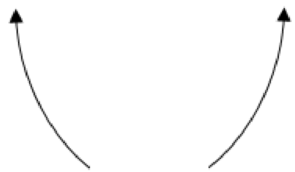




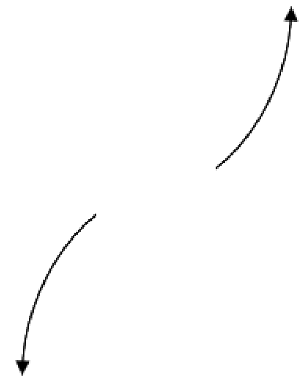
A.



B.



C.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.

---

23. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-3 - 5i \text{ and } -4$$

The solution is $x^3 + 10x^2 + 58x + 136$, which is option D.

A. $b \in [-1, 5], c \in [8, 9.7], \text{ and } d \in [16, 22]$

   $x^3 + x^2 + 9x + 20$, which corresponds to multiplying out $(x + 5)(x + 4)$.

B. $b \in [-1, 5], c \in [6.7, 8.6], \text{ and } d \in [10, 14]$

   $x^3 + x^2 + 7x + 12$, which corresponds to multiplying out $(x + 3)(x + 4)$.

C. $b \in [-15, -8], c \in [56.1, 58.3], \text{ and } d \in [-143, -134]$

   $x^3 - 10x^2 + 58x - 136$, which corresponds to multiplying out $(x - (-3 - 5i))(x - (-3 + 5i))(x - 4)$.

D. $b \in [6, 14], c \in [56.1, 58.3], \text{ and } d \in [130, 141]$

   * $x^3 + 10x^2 + 58x + 136$, which is the correct option.

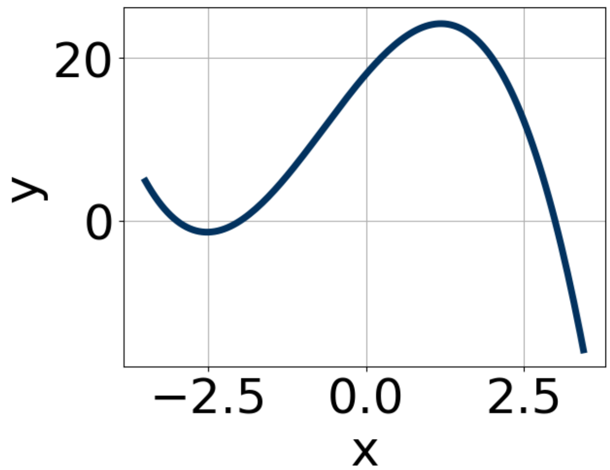
E. None of the above.

   This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-3 - 5i))(x - (-3 + 5i))(x - (-4))$.

---

24. Which of the following equations *could* be of the graph presented below?



The solution is $-2(x+2)^9(x+3)^{11}(x-3)^5$, which is option D.

A. $7(x+2)^6(x+3)^{11}(x-3)^7$

The factor $(x+2)$ should have an odd power and the leading coefficient should be the opposite sign.

B. $-10(x+2)^{10}(x+3)^9(x-3)^9$

The factor -2 should have been an odd power.

C. $11(x+2)^9(x+3)^9(x-3)^9$

This corresponds to the leading coefficient being the opposite value than it should be.

D. $-2(x+2)^9(x+3)^{11}(x-3)^5$

* This is the correct option.

E. $-5(x+2)^4(x+3)^8(x-3)^9$

The factors -2 and -3 have have been odd power.

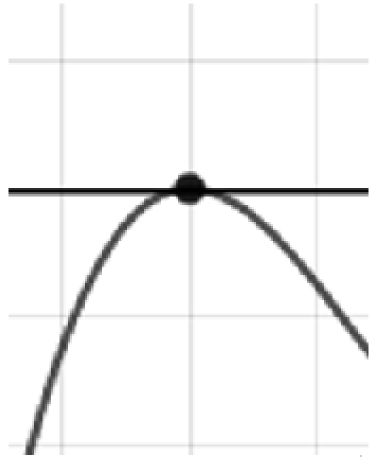
General Comment: General Comments: Draw the x-axis to determine which zeros are touching (and so have even multiplicity) or cross (and have odd multiplicity).

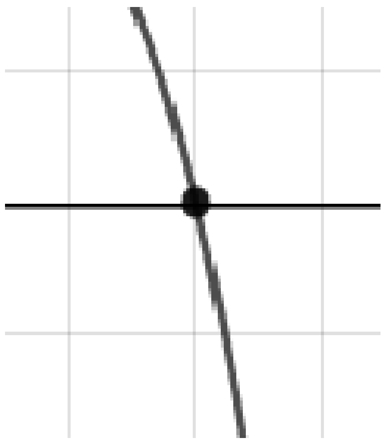
---

25. Describe the zero behavior of the zero $x = -6$ of the polynomial below.

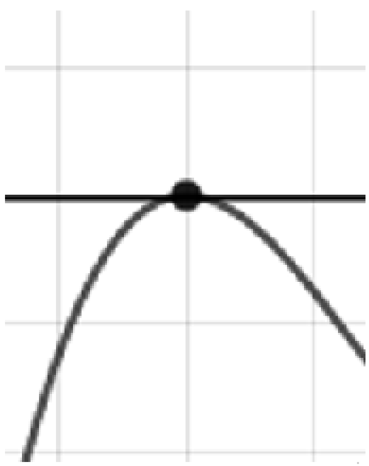
$$f(x) = -9(x-6)^9(x+6)^{10}(x+2)^9(x-2)^{12}$$

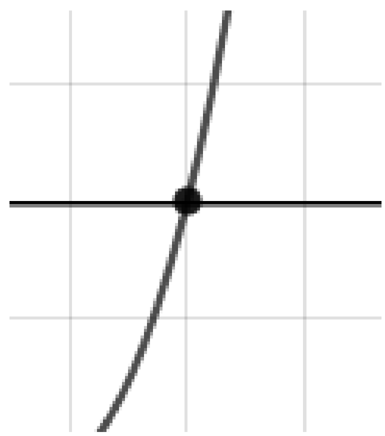
The solution is the graph below, which is option B.



A. 

C. 

B. 

D. 

E. None of the above.

General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

---

26. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$-2, \frac{-7}{3}, \text{ and } \frac{3}{2}$$

The solution is $6x^3 + 17x^2 - 11x - 42$, which is option E.

A. $a \in [5, 11], b \in [16, 20], c \in [-14, -9],$ and $d \in [40, 47]$

$6x^3 + 17x^2 - 11x + 42$, which corresponds to multiplying everything correctly except the constant term.

B. $a \in [5, 11], b \in [-12, -2], c \in [-33, -27],$ and $d \in [40, 47]$

$6x^3 - 7x^2 - 31x + 42$, which corresponds to multiplying out $(x - 2)(3x + 7)(2x - 3)$.

C. $a \in [5, 11], b \in [-43, -32], c \in [63, 68],$ and $d \in [-47, -37]$

$6x^3 - 35x^2 + 67x - 42$, which corresponds to multiplying out $(x - 2)(3x - 7)(2x - 3)$.

D. $a \in [5, 11], b \in [-21, -14], c \in [-14, -9],$ and $d \in [40, 47]$

$6x^3 - 17x^2 - 11x + 42$, which corresponds to multiplying out $(x - 2)(3x - 7)(2x + 3)$.

E. $a \in [5, 11], b \in [16, 20], c \in [-14, -9],$ and $d \in [-47, -37]$

* $6x^3 + 17x^2 - 11x - 42$, which is the correct option.

General Comment: To construct the lowest-degree polynomial, you want to multiply out $(x+2)(3x+7)(2x-3)$

---

27. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $x^3 + bx^2 + cx + d$.

$$-4 - 3i \text{ and } -3$$

The solution is $x^3 + 11x^2 + 49x + 75$, which is option A.

A. $b \in [11, 19], c \in [48.36, 49.78],$ and $d \in [72.6, 77.1]$

* $x^3 + 11x^2 + 49x + 75$, which is the correct option.

B. $b \in [0, 7], c \in [4.02, 6.83],$ and $d \in [7.9, 9.5]$

$x^3 + x^2 + 6x + 9$, which corresponds to multiplying out $(x + 3)(x + 3)$.

C. $b \in [0, 7], c \in [6.29, 9.06],$ and $d \in [11.8, 14.7]$

$x^3 + x^2 + 7x + 12$, which corresponds to multiplying out $(x + 4)(x + 3)$.

D. $b \in [-16, -10], c \in [48.36, 49.78],$ and $d \in [-76, -71.8]$

$x^3 - 11x^2 + 49x - 75$, which corresponds to multiplying out $(x - (-4 - 3i))(x - (-4 + 3i))(x - 3)$.

E. None of the above.

This corresponds to making an unanticipated error or not understanding how to use nonreal complex numbers to create the lowest-degree polynomial. If you chose this and are not sure what you did wrong, please contact the coordinator for help.

General Comment: Remember that the conjugate of $a + bi$ is $a - bi$. Since these zeros always come in pairs, we need to multiply out $(x - (-4 - 3i))(x - (-4 + 3i))(x - (-3))$.

---

28. Construct the lowest-degree polynomial given the zeros below. Then, choose the intervals that contain the coefficients of the polynomial in the form $ax^3 + bx^2 + cx + d$.

$$\frac{-7}{5}, \frac{-1}{4}, \text{ and } \frac{3}{5}$$

The solution is $100x^3 + 105x^2 - 64x - 21$, which is option E.

A. $a \in [100, 104], b \in [-230, -224], c \in [129, 136],$ and $d \in [-21, -15]$

$100x^3 - 225x^2 + 134x - 21$, which corresponds to multiplying out $(5x - 7)(4x - 1)(5x - 3)$.

B. $a \in [100, 104], b \in [-177, -171], c \in [30, 38],$ and $d \in [20, 32]$

$100x^3 - 175x^2 + 34x + 21$, which corresponds to multiplying out $(5x - 7)(4x + 1)(5x - 3)$.

C. $a \in [100, 104], b \in [-112, -104], c \in [-65, -60],$ and $d \in [20, 32]$

$100x^3 - 105x^2 - 64x + 21$, which corresponds to multiplying out $(5x - 7)(4x - 1)(5x + 3)$.

D. $a \in [100, 104], b \in [103, 115], c \in [-65, -60],$ and $d \in [20, 32]$

$100x^3 + 105x^2 - 64x + 21$, which corresponds to multiplying everything correctly except the constant term.

E. $a \in [100, 104], b \in [103, 115], c \in [-65, -60],$ and $d \in [-21, -15]$

* $100x^3 + 105x^2 - 64x - 21$, which is the correct option.

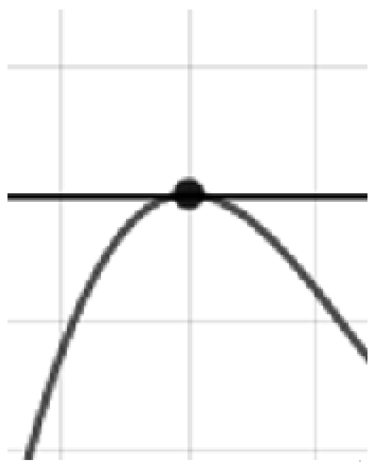
General Comment: To construct the lowest-degree polynomial, you want to multiply out $(5x + 7)(4x + 1)(5x - 3)$

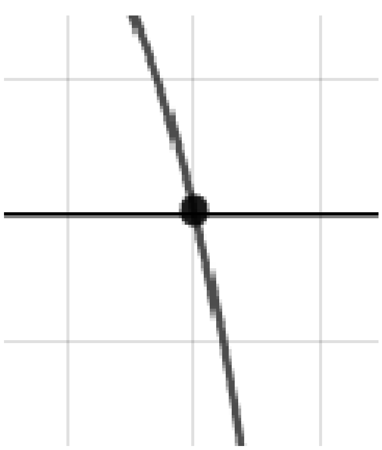
---

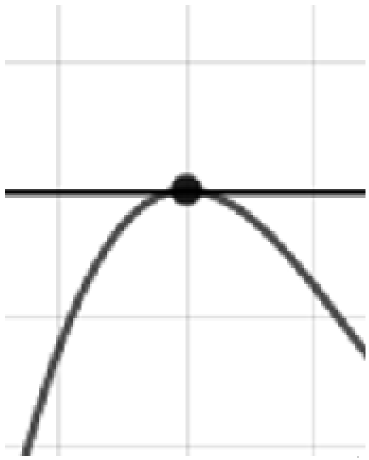
29. Describe the zero behavior of the zero $x = 7$ of the polynomial below.

$$f(x) = -7(x - 3)^{11}(x + 3)^9(x - 7)^{14}(x + 7)^9$$

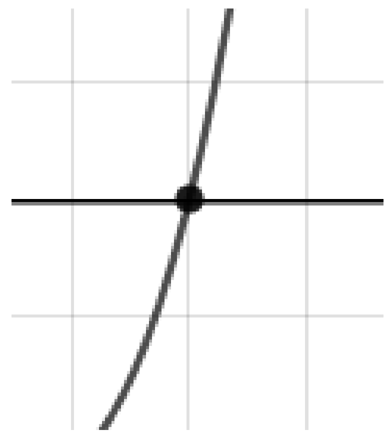
The solution is the graph below, which is option B.



A. 

B. 

C. 

D. 

E. None of the above.

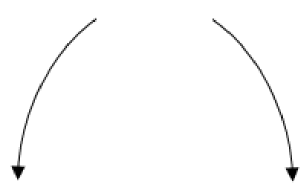
General Comment: You will need to sketch the entire graph, then zoom in on the zero the question asks about.

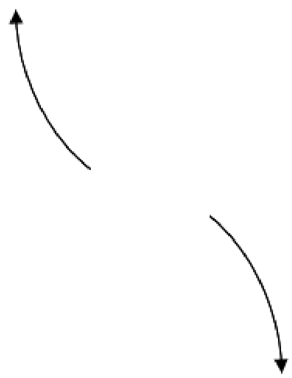
---

30. Describe the end behavior of the polynomial below.

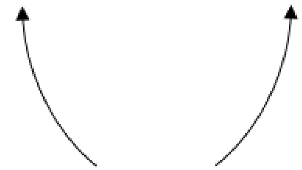
$$f(x) = -3(x+9)^5(x-9)^8(x-3)^2(x+3)^3$$

The solution is the graph below, which is option B.

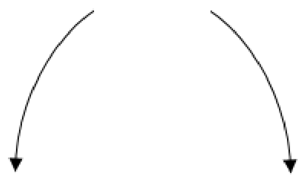




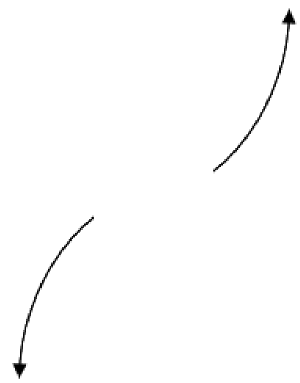
A.



C.



B.



D.

E. None of the above.

General Comment: Remember that end behavior is determined by the leading coefficient AND whether the **sum** of the multiplicities is positive or negative.